Integrated Studies of Oceanographic Processes and Shallow Water Acoustics in the South China Sea: Custom Climatology and Mid-Shelf Field Work

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LONG-TERM GOALS

Our long-term goal is to understand the dynamics of shelfbreak processes in the South China Sea and the associated forcing from the Kuroshio. We also collaborate with acousticians to determine how these processes affect the propagation of low-frequency sound near the shelfbreak.

OBJECTIVES

The objectives of this past year were to finish a climatology of the northern South China Sea shelfbreak and Taiwan Strait as well as to explore issues relating to internal tides near the shelfbreak as well as instability of the Kuroshio in Luzon Strait.

APPROACH

Our approach has been to use climatological tools developed previously for the Middle Atlantic Bight (Linder et al., 2006) to the shelfbreak in the northern South China Sea, the East China Sea, and in Taiwan Strait. We collapsed the data into a single cross-shelf section in order to establish the cross-shelf structure on the scale of the baroclinic Rossby radius. We have also referenced the geostropic velocity fields using seasonally averaged data from shipboard ADCP sections collected by the Taiwanese.

WORK COMPLETED

During the past year, we have submitted a manuscript (Linder et al., 2008) on the climatological work. We have been collaborating with J.-H. Tai of National Taiwan University on a stability analysis of the Kuroshio in Luzon Strait. A paper on the impact of the oceanographic variability on transmission loss near the shelfbreak in the South China Sea has appeared (Emerson et al., 2007).

RESULTS

We have computed a four season, two-dimensional climatology for both Taiwan Strait and the northern South China Sea, centered on the shelfbreak (Figure 1). We found a predominantly northeastward flow near the shelfbreak in the South China Sea, consistent with an anti-cyclonic gyre southwest of Taiwan. Maximum velocities over the upper slope are 40 cm/s. The maximum

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14. ABSTRACT
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15. SUBJECT TERMS

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variability occurs just seaward of the shelfbreak in a depth range of 40 to 80 m for temperature, and near the surface at the shelfbreak for salinity. Transports, using mean barotropic velocities from all available shipboard ADCP sections, are at a maximum in summer (1.8 Sv) and at a minimum in spring (0.1 Sv). The seasonally averaged transports for both the shelfbreak in the northern South China Sea as well as Taiwan Strait appears in Figure 2.

In Taiwan Strait, the dominant variability is present on the western side of the strait and is associated with the China Coastal Current. Maximum transport is to the north and is 1.9 Sv in summer (compared to previous estimates of 1.5 Sv) and a minimum of 0.4 Sv in spring, again northward. The mean and standard deviation fields appear in Figures 3 and 4.

J.-H. Tai is proceeding toward his Ph.D. degree at National Taiwan University after having spent a year at Woods Hole Oceanographic Institution working with G. Gawarkiewicz. He has completed a two-layer model instability analysis of the Kuroshio over ridge topography and is presently comparing his results to moored measurements in Luzon Strait. The basic state for the model was chosen based on sections across the Kuroshio taken August, 2007 using the SeaSoar from National Taiwan University.

We are continuing to do analysis of data collected in April, 2005 (Emerson et al., 2007) with attention on the internal tides. We have identified strong internal bores in the data and are presently examining the bore structure as well as boluses of cold water which appear on the shelf.

IMPACT/APPLICATIONS

We have used the climatology to do planning of field data in the East China Sea for the Quantifying, Predicting, and Exploiting Uncertainty Pilot program, including using the climatological sound speed fields for acoustic propagation modeling. We have a technical report which is web-based and has been distributed to several fleet contacts.

RELATED PROJECTS

This work is closely related to the Quantifying, Predicting, and Exploiting Uncertainty DRI. We have used sampling strategies and equipment (low-cost thermistor moorings) directly in the QPE Pilot Program. We have also used the climatological tools to produce climatological fields which have been used to initialize numerical models and for acoustic propagation modeling in the QPE DRI.

PUBLICATIONS

Emerson, C., P. Abbot, C. Gedney, G. Gawarkiewicz, C.-S. Chiu, C.-F. Chen, and R., Wei, "Acoustic Propagation Uncertainty in the Shallow South China Sea", Proceedings, Underwater Acoustic Measurements: Technologies and Results, Papadakis and Bjorno, ed., 25-29 June, 2007.

Linder, C., G. Gawarkiewicz, J.-H. Tai, and T.-Y. Tang, 2008. A seasonal climatology of Taiwan Strait and the northern South China Sea. J. Geophys. Res.-Oceans, submitted.

FIGURES

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Figure 1- A map denoting the areas used for the climatological fields produced for the northern South China Sea and Taiwan Strait. All data from within the polygon is used and mapped relative to the reference bathymetry (light dashed line). The dark dashed line represents the cross-shelf (NESCS) and cross-strait (TS) section that the data is projected onto.

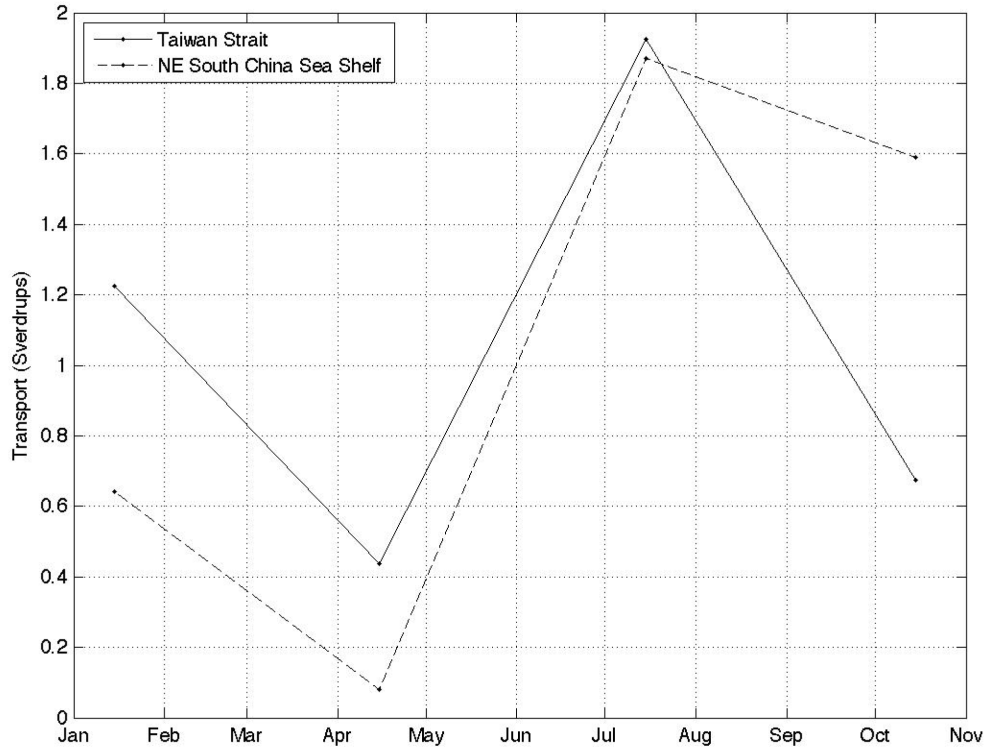

Figure 2- The seasonal variation in transport within the northern South China Sea (dashed line) and Taiwan Strait (solid line).

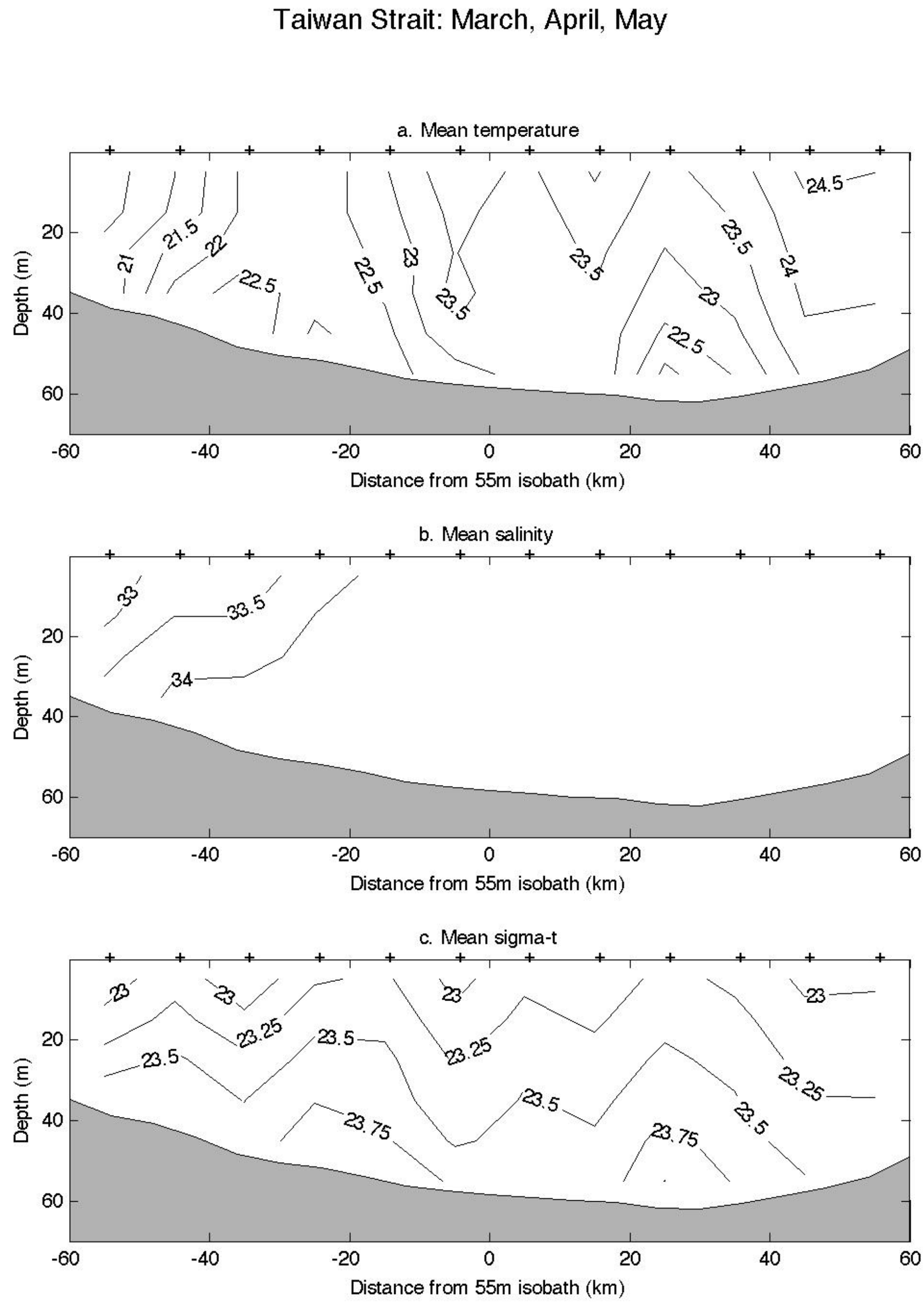

Figure 3- Mean fields of temperature (upper panel), salinity (middle panel), and density (bottom panel) for spring in Taiwan Strait. The bins used for averaging are denoted at the top of the panels. Note the presence of the China Coastal Current in the salinity field at the left side of the figure (western side of Taiwan Strait).

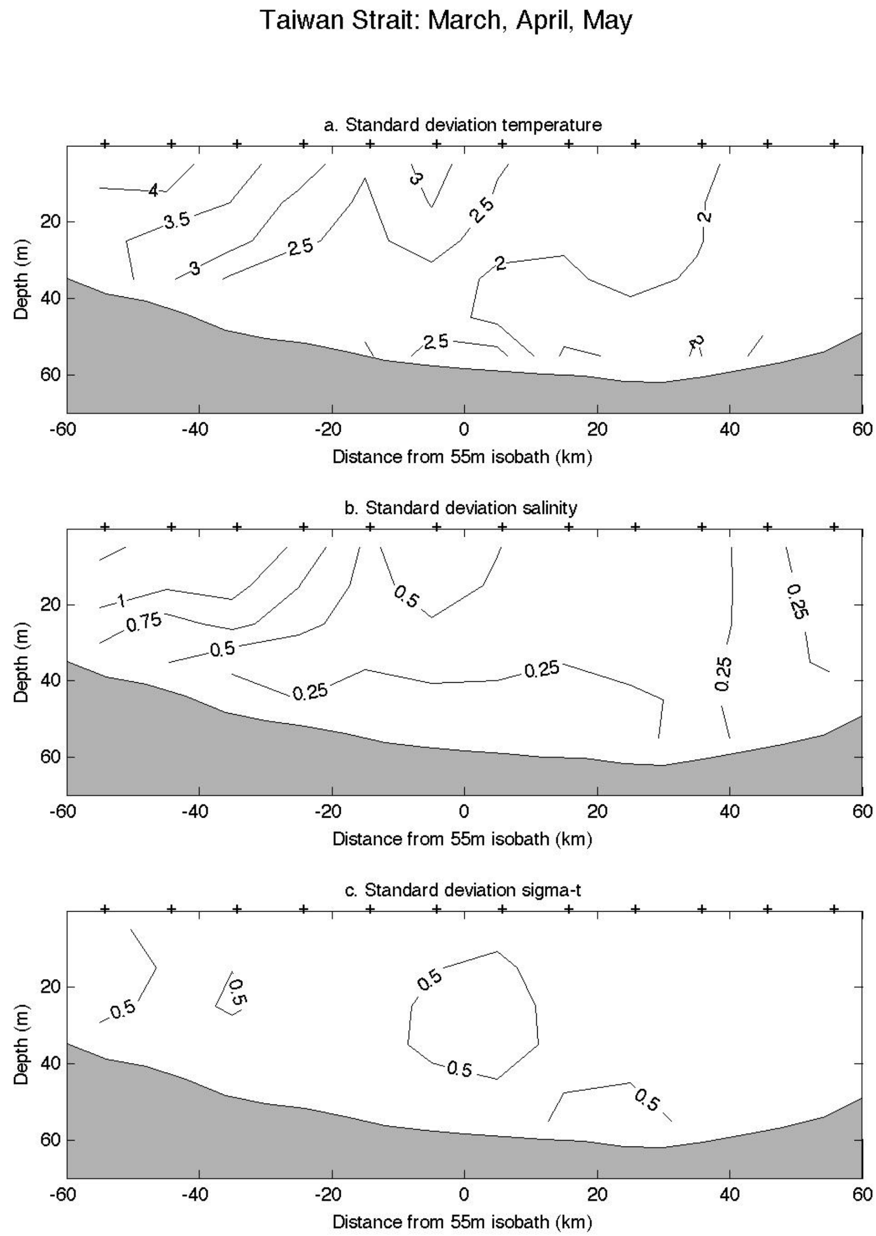

Figure 4- The spatial structure of the variability within Taiwan Strait as expressed in the standard deviation fields. The top panel is temperature, the middle panel is salinity, and the bottom panel is density. The maximum standard deviations appear at the western end of the strait and are associated with the China Coastal Current.